The future promise of the Columbia Basin, even now called the Inland Empire, when its waters are assigned their full duty, is best expressed in terms of the run-off of its three tributaries: Upper Columbia or Kootenay, 53,000,000 acre-feet; Pend Oreille, already center of a wide project, 19,000,000 acre-feet; and Snake, 45,000,000 acre-feet. But the presence of volcanic soil makes this promise larger, for even at low stages the net recovery on the Snake, after practically the entire flow has been used four times, is still 39 per cent.

The problem of building up the lesser but warmer Colorado Basin is even now at the door, and the equitable division of the water before it passes down the stream will underlie the development of seven States. The Green will furnish 5,700,000 acre-feet, the Grand 7,500,000 acre-feet, and the San Juan 3,100,000 acre-feet. The tiny Gila will furnish only 1,000,000 acre-feet, and of this only 159,000 acre-feet flows in April–July, when the need is greatest.

However, from this and other small additions, must be deducted 1,800,000 acre-feet, much of which apparently sinks in the delta above Yuma and seeps slowly to the Gulf. The problem of reclaiming this underground flow by artificial dikes will depend upon the relative value of the completed work.

THE CLIMATE OF BRITISH COLUMBIA

By F. NAPIER DENISON

[Meteorological Office, Victoria, B. C.]

Owing to the mountainous character of portions of this Province, its climate varies greatly according to local physical conditions.

The heaviest precipitation occurs on the western slopes of the Coast Ranges, the lightest between the coast and Selkirks, and increases eastward to the Rockies. The heaviest precipitation amounts to 120 inches on the west coast of Vancouver Island, about 180 inches on the high levels to the eastward of the city of Vancouver, while the wettest area on our coast is in the vicinity of Swanson Bay, near Princess Royal Island. Owing to the less mountainous character of the Queen Charlotte Islands as compared with Vancouver Island, the precipitation there is lighter, amounting to about 100 inches on the west coast and 50 inches on the eastern side.

Between the Coast and the Selkirk Ranges much of the southern area is termed the "dry belt," while extending northward between these ranges, which decrease in altitude, the Pacific Ocean LOWS spread inland and sufficient precipitation occurs for general vegetation. Further eastward climatic conditions become decidedly local throughout the Selkirk and Rocky Mountains.

The following table gives the average annual precipitation for certain typical stations, extending from the west coast to the Rockies across both southern and northern British Columbia. The elevations are also given.

TABLE 1.—*Average precipitation and elevation of certain British Columbia stations*

Station	Elevation	Precipitation
Southern group	*Feet*	*Inches*
Clayoquot	27	119.13
Nanaimo	125	37.46
Victoria	230	27.65
Vancouver	136	58.76
Kamloops	1,262	10.08
Penticton	1,200	11.21
Nelson	2,230	26.86
Invermere	2,650	11.47
Northern group		
Masset Q. C. I.	10	53.99
Prince Rupert	170	101.74
Prince George	1,867	18.11
Fort St. James	2,280	15.75
Barkerville	4,180	36.63
Glacier	4,072	60.24

Even at the low level of 27 feet on the western coast of Vancouver Island the precipitation is 119 inches, while in crossing the island to Nanaimo the yearly total drops to 37 inches, and at the southeastern part of the island about Victoria it is only 27.65 inches. The influence of the mainland coast mountains is clearly seen by the marked rise to 58 inches at Vancouver, while Kamloops and Penticton in the "dry belt," where irrigation has made a wonderful fruit-growing district, only 10 and 11 inches, respectively, is the annual amount. At the higher elevation at Nelson in Kootenai the precipitation rises again to 27 inches.

Crossing the northern part of the Province, Masset on the east coast of the Queen Charlotte Islands has 54 inches and Prince Rupert on the north coast mainland 102 inches, while east of the coast mountains the northern interior has from 6 to 8 inches more precipitation than in the southern interior, already mentioned. Barkerville in Caribou and Glacier in the Rockies are given to show the increased precipitation at stations over 4,000 feet.

In connection with heavy precipitation in this Province, it appears that at Henderson Lake on the west coast of Vancouver Island, where we now have a station, the annual precipitation was 228 inches in 1923, with 79 inches in December, and in 1924 the yearly total was 281 inches. It is probable that owing to peculiar local conditions this station may prove to be the wettest spot not only in this Province but on the North Pacific coast.

Mean temperature and bright sunshine.—In the following table the mean temperature is shown for the coldest and warmest months of the year, together with the annual amount of bright sunshine, for certain typical stations, including Edmonton, Alberta, for purposes of comparison.

TABLE 2.—*Mean temperature and bright sunshine*

Station	January	July	Range	Annual hours sunshine
	°F.	°F.	°F.	
Victoria	39	60	21	2,163
Nanaimo	36	63	27	1,898
Prince Rupert	32	57	25	1,214
Vancouver	36	63	27	1,829
Kamloops	22	69	47	2,118
Vernon	21	66	45	2,089
Summerland	22	68	46	2,034
Nelson	25	66	41	1,895
Grand Forks	20	69	49	----------
Invermere	13	63	50	1,994
Cranbrook	17	62	45	----------
Edmonton, Alberta	6	61	55	2,137

In connection with these figures one is struck by the remarkably small seasonal range of temperature and large amount of sunshine as shown at Victoria. These conditions are due to the open nature of the land about there, and the moderating influence of the ever-changing tidal waters which almost surround that portion of Vancouver Island affect the temperature.

The seasonal range of temperature increases eastward to the dry belt and where the annual amount of bright sunshine is naturally high, yet still less than at Victoria.

The temperature extremes are greatest in Kootenai in the list of stations. A comparison shows that the southeastern portion of Vancouver Island records more bright sunshine than even parts of "Sunny Alberta."

THE CLIMATE OF OREGON DURING THE PLEISTOCENE PERIOD

By EDWIN T. HODGE, Professor of Geology

[University of Oregon]

(Author's Abstract)

Previous studies of the Pleistocene of British Columbia, Washington, and Oregon have brought out two statements regarding the climate of that time. They state that "the temperature gradually grew colder and finally culminated in the development of glaciers" and that a great sound occupying the Willamette Valley was developed at the close of the Pleistocene. This latter statement, if true, would likewise indicate a colder climate. The presence of a large body of water, in contrast to an equivalent land surface, reflects most of the light energy received, its latent heat is high, and evaporation from whatever cause results in cooling.

As a result of studies extended over the past eight years I have arrived at conclusions which materially differ from those hitherto published regarding geological events of the Pleistocene period of Oregon and Washington. These conclusions will be published elsewhere. If my theory regarding the events of the Pleistocene are correct, then the following deductions may be made regarding Pleistocene climate:

The period was introduced by the Pliocene uplift. This uplift continued into the Admiralty epoch, which brought the Coast Range and Cascades to an elevation whereby they intercepted a large part of the moist winds coming from the Pacific Ocean. The moist winds during most of the Pliocene were able to pass over the low mountains and fed large lakes in eastern Oregon, Washington, and California. The increment in the precipitation, due to the elevation along this coast, in the less-favored localities amounts to

more than 1 inch per each 100 feet. Because of the elevation and winter precipitation most of the water fell in the form of snow, and glaciers were developed. This robbing of the winds of their moisture by the Coast and Cascade Ranges dried up the lakes of eastern Oregon. Glaciers developed in this manner would not result in a reduction in the average temperature of western Oregon. On the contrary, these winds would contribute to Oregon the heat which they obtained from the warm Pacific. The moisture condensing to clouds and the cloud particles crystallizing to snow would cause these winds to give up their heat as a direct contribution to Oregon. The temperature undoubtedly was higher rather than lower. The above explanation involves no change in world climate, nor change in direction of wind, nor change in moisture content of the winds.

In the Puyallup epoch there was a subsidence of over 1,000 feet, which reduced the mountain crests to one lower than that of the present time. The moist westerly winds again were able to pass over western Oregon retaining much of their moisture which was precipitated in eastern Oregon, producing large lakes.

In the Vashon epoch elevation again took place, resulting in a second period of glaciation and the drying up of the lakes in eastern Oregon. At the close of the Vashon epoch there has been a subsidence resulting in the drowning of most of the river valleys of the Pacific Northwest. This subsidence, however, was not equal to that of the Puyallup epoch and consequently no great lakes have been developed.

Thus there were two uplifts and two glacial periods in Admiralty and Vashon time. Waters derived from their glaciers cut large valleys in western Oregon and on the flanks of the Cascades in eastern Oregon. There were two lake stages, one in pre-Admiralty and one in the Puyallup. The lakes of this second period have been drying up since that time. During the Puyallup period, and while the Admiralty glaciers were melting, aggradation on a large scale filled the Willamette Valley with sediments to an elevation of about 600 feet in the vicinity of Portland and about 150 feet in the vicinity of Eugene.

Further evidence that the climate was warm and that no chilling bodies of water existed is shown by the entire absence of marine fossils and by the presence of fossils of plants and animals requiring a warm climate. In western Oregon many fossil remains of the mammoth, mastadon, giant sloth, camel, and horse have been found. Fossil remains of the walnut, oak, willow, and sequoia have been found. The sequoia is apparently the same as the living sequoia in California at the present time and the oak and walnut are closely related to living species. These creatures could not have lived in Oregon had the climate been cold and would have been driven out if the valley had been occupied by a great sound. The glacial débris found in the Willamette Valley represent iceborne fragments which floated down the Willamette Valley while the valley was flooded by river waters in the Puyallup epoch.

This interpretation of the geology makes it possible for men to have migrated down the Pacific coast under favorable conditions and to have lived in the Willamette Valley during the glacial period. Fossil remains of a race of men antecedent to the Indians, which the white men found in this valley, have been found under conditions which would indicate that man was here during the Puyallup Epoch.

VARIABILITY OF PRECIPITATION IN THE STATE OF WASHINGTON

By M. B. SUMMERS

[Weather Bureau, Seattle, Wash.]

(Abstract)

The average precipitation in the State of Washington for individual months has varied between a trace and about 400 per cent of the mean of 35 years of record. The greatest variance occurs in the summer months and the most frequent variance in the region of the Cascades. In general, the greatest amount that has been received in any 12 consecutive months has been about double that of the driest similar period in the western division, and about three times the driest period in the eastern division. A singular feature of the variability in the eastern division is the fact that the July rainfall is above 150 per cent of the mean in about one year in three, and less than 50 per cent of the mean in about one year in three.

A rather rhythmic fluctuation in the precipitation curve is apparent from 1900 to 1907, with an average period of about 18 months.

FLOODS IN THE WILLAMETTE RIVER

By EDWARD LANSING WELLS

[U. S. Weather Bureau, Portland, Oreg.]

(Author's abstract)

This paper outlines problems connected with the forecasting of floods in the Willamette River.

The drainage basin has an area of approximately 11,000 square miles, varying greatly in surface and exposure, rising from near sea level to more than 10,000 feet.

The climate is mild and equable, with precipitation ranging from 38 inches to more than 100 inches, and averaging about 65 inches. The precipitation is distinctly seasonal.

There are 12 important tributaries, and there is no stretch of more than 50 miles without the entrance of one or more of these.

Rating tables form the best basis for relating stages at successive stations, but these are not available for all stations.

The river changes character as it drops over the falls at Oregon City, becoming, in a sense, an arm of the sea.

The difference between crest stages at Salem and Portland is greater in extreme floods than in ordinary floods, and is greater when the Columbia is low, but this relation is not constant.

Rises often begin at Portland almost as soon as at upstream stations.

NOTES, ABSTRACTS, AND REVIEWS

EVAPORATION MEASUREMENTS IN THE SWISS ALPS

J. Maurer and Otto Lütschg in Meteorologische Zeitschrift for March, 1925, pp. 111–114, summarize their results as attained thus far. Preliminary investigations were made in 1911–12, the results being published in Meteorologische Zeitschrift, 1911, no. 12, and 1913, no. 5. In the summer of 1915, with the physical and financial resources of the Swiss Federal Bureau of Water Control at their service, intensive studies were begun.

These were carried on at first with open circular vessels of sheet zinc (evaporation pans) of 30 and 50 cm. diameter and depth, respectively, supplemented by Livingston porous cup atmometers and glass vessels of 24 and 28 cm. diameter and 8 cm. depth, in the upper Saas Valley at the various altitudes indicated for the stations for which data are plotted in Figure 1, these data representing conditions in 1920. Evaporation measurements were always accompanied by observations of the meteorological elements. Evaporation pan measurements were carried out on Lake Mattmark, at about 2,100 meters above sea level, during the summers of 1915 and 1916. The summer of 1915 gave 24-hour evaporation values ranging between 6.2 mm. and 2 mm., according to the weather. The maximum value represents a warm and entirely clear period with light north wind. In 1916 the July and August 24-hour values ranged from 1.6 mm. and 3.4 mm.

The principal series of observations was made at the Hopschensee, 2,017 m. above sea level, west of the Simplon Pass, between July 25 and October 23, 1921. These were carried through by means of hydrometrical methods, taking account of the inflow and outflow and direct precipitation which affected the level of the lake. Coincident with these, a series of porous cup atmometer and glass vessel determinations was made in the meadow directly on the lake shore, the corresponding meteorological observations being taken also.

Table 1 for the Hopschensee summarizes evaporation from this lake by certain calendar groups of days without regard to weather conditions. Table 1a for the same lake divides the data for the same total period into groups according to weather type, a much more significant procedure. Table 2 summarizes the results obtained by